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ABSTRACTS

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- Organic Devices, Molecular Electronics
- Fabrication Technique and Characterization
- Liquid Crystals, Polymers, and Other Soft-Materials
- Biomolecular Electronics and Bioanalysis
- Nanocarbon and Nanotechnology

Photo-controlled Organic Thin Film Transistors

Using Soluble π -Conjugated Molecules

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We fabricated photo-sensitive organic thin film transistors using soluble π -conjugated molecules, such as star-shaped 4(HPBT)-benzene and 4(HP3T)-benzene molecules having a relatively high quantum yield and TIPS-pentacene having a high mobility. The 4(HPBT)-benzene based organic photo-transistors (OPTs) exhibited high photo-sensitivity (2500 ~ 4300 A/W) even with low optical powers (6.8 ~ 30 $\mu\text{W}/\text{cm}^2$) at zero gate bias. The measured photo-sensitivity of the devices was much higher than that of inorganic single crystal Si based photo-transistors, as well as that of other OPTs reported earlier. With the highly photo-sensitive characteristics of the 4(HPBT)-benzene based OPTs, we observed the high ratio of on and off current switching as $\sim 4 \times 10^4$ with low optical power and low gate bias [1]. Photo-induced charges affect to the trapped electron density of gate-insulator-semiconductor interface. Using these photo-enhanced charge trapping phenomena at the interface, we could control the threshold voltage and lead to a reproducible memory operation for soluble 4(HPBT)-benzene, 4(HP3T)-benzene, and TIPS-pentacene based OPTs. For the TIPS-pentacene based OPTs, the on-state and off-state current ratios of the memory operation with incident light were ~ 55 times higher than those with dark conditions. We also present the e-beam treated effect using pentacene based devices.

[1] M.Y. Cho, et al., Adv. Funct. Mater. 18, 2905 (2008).